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ADAP 94-8

# Crop Production for Pacific Islands

## Student Workbook

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**Crop Production For Pacific Islands - Student Workbook**

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# Crop Production for Pacific Islands

## Student Workbook

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# Crop Ecology 1

## Performance Objectives

Upon completion of this chapter each student should be able to:

A. Define the 24 terms related to crop ecology.

B. Explain the three steps in the process of ecological succession.

C. Describe the forest/plant communities found on the student's home island including locations and some dominant species.

E. Explain the relationship between adaptation, niches, habitats, and competition; for plants growing in a natural ecosystem and also in an agroecosystem.

F. Explain the relationship between energy flow and nutrient cycling in natural ecosystems and agroecosystems.

G. Describe the differences in nutrient cycling between tropical and temperate ecosystems.

H. Describe the goal of agroecosystem management and the means of accomplishing the goal.

I. Explain the difference between biomass and yield.

J. Give at least three examples of how soil resources can be damaged by agroecosystem imbalances.

K. Give at least three examples of how water resources can be damaged by agroecosystem imbalances.

L. Give at least two examples of how food webs can be damaged by agroecosystem imbalances.

M. Identify crop production practices that can reduce damages caused by agroecosystem imbalances.

# Terms

ADAPTATION- Changes in a species over time that allow it to better meet the needs of the environment.

AGROECOSYSTEM- Managed populations or communities of harvestable crops, together with all of the organisms and environmental factors influencing them.

ATOLL- A coral reef resting on a volcanic island base that usually has brackish ground water and limited mineral soil.

BIOMASS- The weight of all organisms in a given area that is measured to determine ecological productivity and efficiency.

BIOTIC COMMUNITY- The living parts of an ecosystem.

BRACKISH WATER- Salt and fresh water mixed together.

CLIMAX COMMUNITY- The species that exist at the final stage of ecological succession.

COMPETITION- The condition that exists when a limited supply of resources are required by more than one organism.

ECOLOGICAL BALANCE- The condition that exists when limited resources are conserved and the biotic community returns as much to the environment as it removes.

ECOLOGICAL DIVERSITY - A measure of the number of different species in an ecosystem.

ECOLOGICAL STABILITY- A measure of ecological balance despite moderate changes in the physical environment (temperature, light, moisture) or increased pressure due to pests or diseases.

ECOLOGICAL SUCCESSION- The process of changes in numbers and types of species within an ecosystem over time, that leads to a climax community.

ECOSYSTEM- All living and nonliving things in a given area that operate together through interaction and interdependence, forming a single unit.

ENVIRONMENT- The nonliving parts of an ecosystem.

EROSION- The movement of soil particles by wind or water.

ESTUARY- A location where fresh and saltwater mix.

HABITAT- The place an organism lives in the ecosystem.

LEACHING- The downward movement of nutrients through the soil.

MONOCULTURE- An agricultural system that produces only a single crop species.

NICHE- The functional role of an organism in an ecosystem.

NUTRIENT CYCLING- The movement of nutrients over time from an environment to organisms and back to the environment.

STRAND- The vegetation growing closest to the ocean, usually vines growing on sand or grasses in rocks.

VEGETATION INVENTORY- A study of the plant resources of a specific area.

YIELD- The weight or volume of a harvested crop.

# I. Ecological Foundations

## A. Review

Review Chapters 20, 21 and 22 of *Plant Science for Pacific Islands.*

1. **What is an ecosystem?**

   a. ECOSYSTEM

   b. A framework to study natural and man-made systems.

   c. The size, location, and number of components are flexible.

2. **What are the rules of ecological succession?**

   a. ECOLOGICAL SUCCESSION

   b. ENVIRONMENT

   c. BIOMASS, DIVERSITY and STABILITY

## B. Pacific Island Ecosystems

1. **How has ecological succession occurred on Pacific Islands?**

   a. Primary succession

   b. Rainforest ecosystems

   c. Habitable by people

   d. Human actions

   e. Successional communities and environment affect present uses.


Study materials on the native and introduced plants on your island.

2. **What types of forest communities are currently found in Pacific islands?**

a. VEGETATION INVENTORY

b. Major forest types identified by inventories conducted in the region.

i. UPLAND FOREST

ii. SECONDARY FOREST

iii. AGROFOREST

| *Forest Communities* | American Samoa | Hawaii | No. Marianas | Kosrae | Palau | Ponpei | Truk | Yap |
|---|---|---|---|---|---|---|---|---|
| Upland Forest | * | * | | * | * | * | * | * |
| Secondary Forest | * | * | * | * | * | * | * | * |
| Agroforest | * | * | * | * | * | * | * | * |
| Mangrove Forest | * | | * | * | * | * | * | * |
| Coastal Forest | * | * | * | | | * | | |
| Atoll Forest | | | * | | * | * | * | * |
| Moss (Dwarf) Forest | * | * | | * | | * | | |
| Swamp Forest | | | | * | * | * | | * |
| Plantation Forest | | * | | | * | * | * | |
| Limestone Forest | | | * | | * | | | |
| Palm Forest | | | | | | * | * | |

iv. MANGROVE FOREST

v. COASTAL FOREST


Use the vegetation inventory for your area to study the locations and components of local forest communities

vi. ATOLL FOREST

vii. MOSS (Dwarf)) FOREST

**C. Ecological Concepts and Crop Production**

1. **How are adaptations, niches, and habitats related to crop production?**

a. ADAPTATIONS to a particular set of environmental conditions.

b. NICHE

HABITAT

c. Crop production practices create habitats and niches

2. **What is competition and how does it relate to crop production?**

a. COMPETITION

b. Agricultural niches and habitats

3. **How does energy flow relate to crop production?**

a. The primary source of energy for natural ecosystems is the sun.

b. Food webs within a climax community are at an ecological balance.

ECOLOGICAL BALANCE

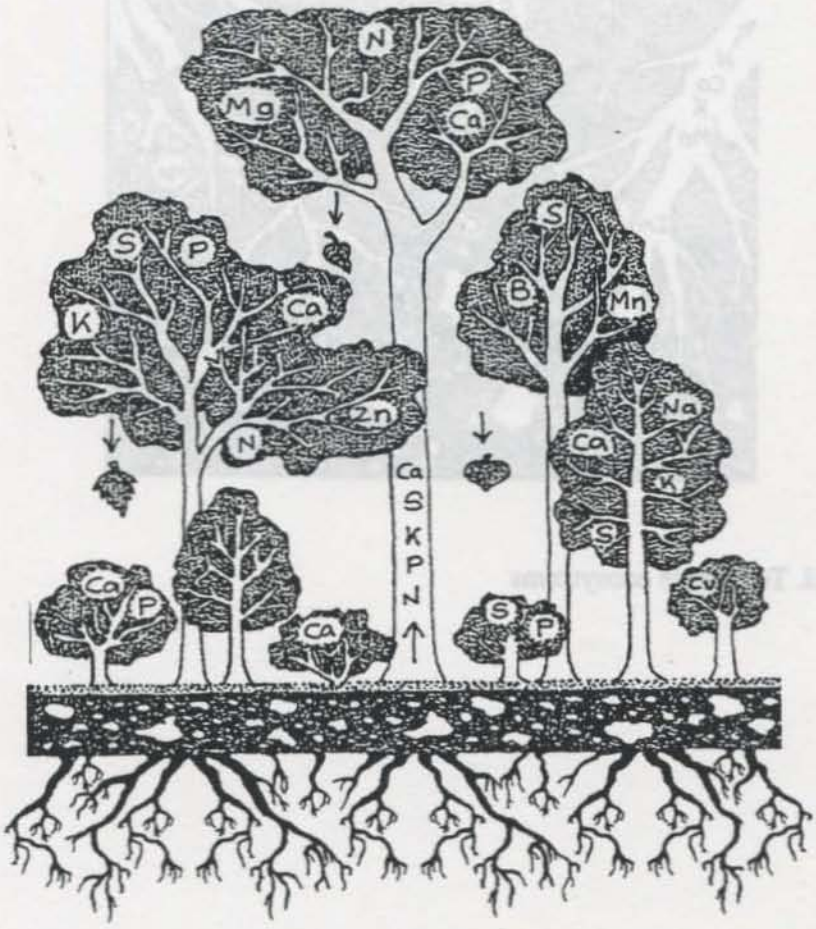
c. Crop production harvests

External energy inputs

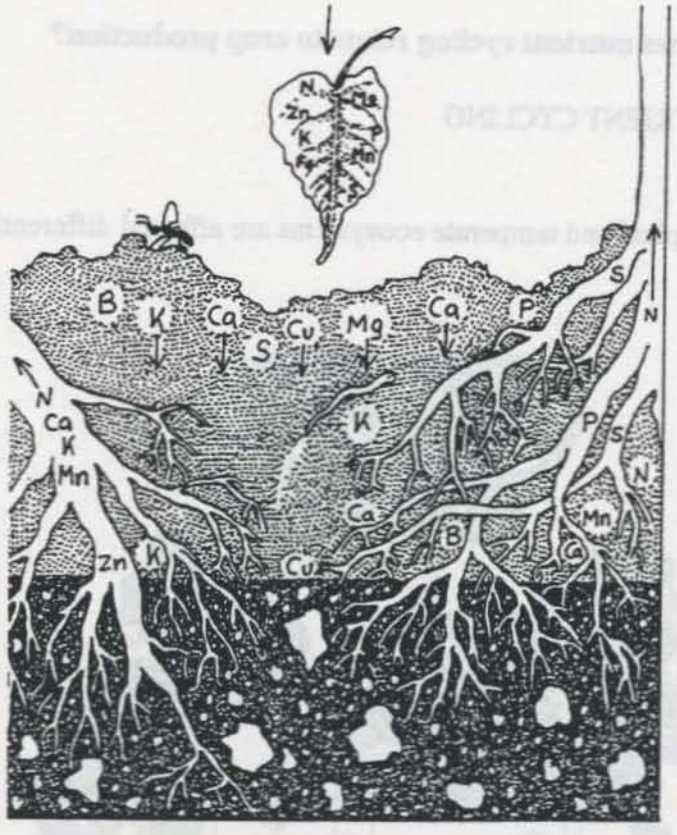
4. **How does nutrient cycling relate to crop production?**

a. NUTRIENT CYCLING

b. Tropical and temperate ecosystems are affected differently.



c. Tropical ecosystems




d. Temperate ecosystems

# II. Agroecosystems

## A . Agroecosystem Concepts

### 1. What are agroecosystems?

a. AGROECOSYSTEMS

b. Measurable level of diversity and stability

Energy flow of inputs and outputs

### 2. Why are agroecosystems managed?

a. Goal of managing an agroecosystem

YIELD is the amount of a crop harvested for use.

b. Creating a niche environment for the cultivated species

c. Pest/diseases

### 3. How is succession managed in different agroecosystems?

a. A multi-crop agroforestry system

b. A MONOCULTURE system

### 4. How is energy flow managed in different agroecosystems?

a. Additional inputs

i. Organic and inorganic materials

ii. Energy inputs

iii. Fossil fuel

iv. Unstable systems

b. Increased outputs

**B. Agroecosystem Imbalance**

May cause damaging affects within and outside the agroecosystem. These damages effect soil and water resources as well as plants, animals, and people.

1. **How can soil resources be damaged by imbalances?**

a. Chemical salts

b. Limited fertility inputs

LEACHING

c. EROSION

Study examples of local agroecosystem imbalances.

Discuss crop production practices that can correct the imbalances.

2. **How can water resources be damaged by imbalances?**

a. Eroded soils

b. Pesticides used or disposed of improperly

c. Fertilizers

3. **How can food webs be damaged by imbalances?**

a. Understanding food webs in the agroecosystem

b. Removal of predators

c. Introduced predators

# Crops and Climates 2

## Objectives

Upon completion of this chapter each student should be able to:

A. Define the 55 terms related to crops and climates

B. Explain the difference between weather and climate.

C. Define the four basic elements of climate change.

D. Describe the four primary factors that affect the elements of climate.

E. Explain how quantity and quality of light are measured.

F. Explain the effects of latitude on daylength and light intensity for areas close to the equator.

G. Name and explain four ways light affects plants.

H. Explain how flowering and modified stem growth can be affected by daylength.

I. Explain the differences between C3, C4, and CAM plants.

J. Explain four ways crops can be manipulated to optimize light interception.

K. Determine the crop density of a planting area.

L. Convert temperature measurements between the Fahrenheit and Celsius scales.

M. Explain four factors that affect temperatures in different locations.

N. Describe three processes of heat transfer.

O. Explain at least four factors that affect temperatures in different locations.

P. Describe four plant responses to cooler temperatures.

Q. Explain three ways plants avoid heat stress.

R. Describe three ways that quantity of precipitation is measured and how these affect crop production.

S. Explain seven ways water affects plants.

# Chapter 2 objectives, continued

T. Describe three ways soil affects water availability.

U. List six factors that affect transpiration.

V. Explain five negative effects of high precipitation on crop production.

W. Explain eight ways crop production practices can optimize crop growth under different precipitation conditions.

X. Name and describe three categories different storm categories based on wind speed.

Y. Describe three air quality factors and their affects on plants.

Z. Describe three effects of air movement on crop production.

AA. Explain the three major contributing factors to global warming.

# Terms

ABSORPTION SPECTRUM- The various wavelengths of light that are absorbed by a plant part or pigment.

ALTITUDE- The vertical elevation of an object or area above sea level.

ASPECT- The position (or side) of a slope facing a particular direction.

BRITISH THERMAL UNIT (BTU)- The amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit.

CALORIE (cal)- The amount of heat required to raise the temperature of 1 gram of water by one degree Celsius.

CELSIUS SCALE (C)- The measurement of temperature in which zero degrees is the freezing point of water and 100 degrees is the boiling point.

CHILLING REQUIREMENT- The number of hours below a given specific temperature required for buds to break dormancy.

CLIMATE- A description of the weather conditions commonly found in a region over time.

CONDUCTION- The flow of heat through a substance.

CONTOUR PLANTING- The practice of cultivating and planting land along lines of equal elevation to reduce soil and nutrient erosion.

CONVECTION- The transfer of heat by a moving fluid or gas.

CONVERGENCE ZONES- Areas between 10 degrees north and 10 degrees south latitude that develop accumulated clouds and gusting winds created by changes between the air and water temperatures.

CROP DENSITY- The relationship between the quantity of plants and the size of the planting area.

DAY LENGTH- The amount of time between sunrise and sunset.

ELECTROMAGNETIC SPECTRUM- The range of radiant energy from wavelengths of less than 0.001nm (cosmic and gamma rays) to greater than 100,000 nm (radio waves).

ETIOLATION- The effect of insufficient light, which causes a plant to grow a long, thin stem and small leaves.

FAHRENHEIT SCALE (F)- The measurement of temperature in which 32 degrees is the freezing point of water and 212 degrees is the boiling point.

GREENHOUSE EFFECT- The absorption and retention of solar radiation by the Earth's atmosphere.

HARDENING OFF- The treatment of tender plants to help them to survive in a more adverse environment.

HEAT- A form of energy that increases the temperature of a body of matter when it is transferred, so long as the body of matter does not change state, (water to ice, water to steam, etc.).

HUMIDITY- Water vaporized in the air.

INFILTRATION RATE- The maximum speed at which water can enter the soil under specific conditions.

INSOLATION- The solar radiation that reaches the Earth's surface.

IRRIGATION- The application of water to a crop or area of soil by means other than natural rainfall.

IRRADIANCE- The amount of sunlight falling on a unit area of surface.

KNOT- A nautical speed measurement equal to 1.15 miles per hour.

LATITUDE- The angular distance of a location north or south of the equator, measured in degrees.

LEAF AREA INDEX (LAI)- The leaf surface area over a unit area of soil.

LEAF ORIENTATION- The arrangement of leaves in space with reference to an axis (line) perpendicular to the ground.

LIGHT- The portion of the electromagnetic spectrum (400 to700 nm) that can be seen by the human eye.

LIGHT COMPENSATION POINT- The level of irradiance at which the amount of $CO_2$ being fixed by photosynthesis equals the amount lost in respiration.

LIGHT SATURATION LEVEL-The point where $CO_2$ becomes the limiting factor in increased photosynthesis.

LUMEN (lm)- The amount of light from a standard candle onto an area one foot square. This measure is also referred to as a footcandle (fc).

MICROCLIMATES- The atmospheric conditions of relatively small areas that differ significantly from those in surrounding region.

MONSOON- Conditions that create a climate that is very dry during most of the year followed by extremely heavy precipitation in the rainy season.

MULCH- Any material that is spread over the soil surface to control erosion and/or weed growth.

PHOTOPERIODISM- The developmental response of plants to the length of the light and dark periods of a day.

PHOTOSYNTHETICALLY ACTIVE RADIATION (PAR)- That fraction of the solar spectrum where quanta have sufficient energy to drive the photosynthetic process.

PRECIPITATION- Condensed water vapor that falls from the sky as rain, hail, or snow.

PRUNING- The removal of plant parts to maintain a desirable form by controlling the direction and amount of growth.

QUANTA- The discreet unit of light energy absorbed by pigment molecules such as chlorophyll.

RADIATION- The flow or transfer of energy without any connecting medium.

RELATIVE HUMIDITY- The ratio of the weight of water vapor in a given quantity of air to the total weight of water vapor that quantity of air is capable of holding at a given temperature.

SOIL CONSERVATION- The wise use of land resources through a combination of appropriate practices.

STRATIFICATION- The process of breaking seed dormancy by cold treatment.

SUNLIGHT- Solar radiation; the ultimate source of almost all energy on Earth.

TEMPERATURE- A measure of the intensity of heat in a body of matter.

THERMOPERIODISM- The need for alternating warm and cool temperatures to influence flowering and/or vegetative growth.

TRADE WIND- A seasonal pattern of air movement toward the equator that is found in the tropics.

VERNALIZATION- The induction of flowering by exposure to cool temperatures.

WATER POTENTIAL- The tendency of water molecules to diffuse, evaporate or be absorbed from one area to another.

WATER STRESS- The condition that occurs in plants when water loss exceeds water uptake, causing a reduction in leaf water content.

WEATHER- The state of the atmosphere at a given place and time.

WIND- The natural or artificially induced movement of air.

WINDBREAK- A planting of trees and/or tall perennials used to deflect air movement around crops, land, and structures to be protected.

# I. Introduction

1. **What is the difference between weather and climate?**

2. **What are microclimates?**

3. **What are the four basic elements of weather and climate?**

4. **What are the primary factors (and relation to elements) that determine the climate of a specific place?**

# II. Climatic Elements Affecting Plant Growth

## A. Light

### 1. How is light measured?

a. Quantity

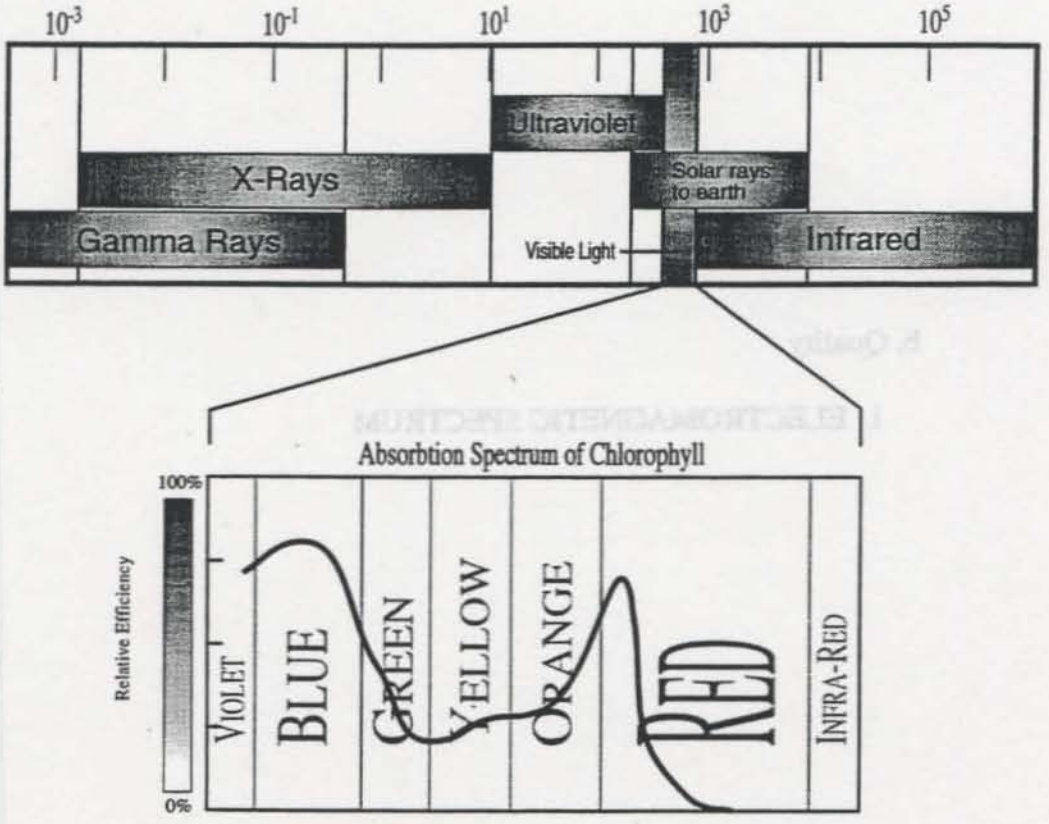
b. Quality

i. ELECTROMAGNETIC SPECTRUM



ii. SUNLIGHT

Review photosynthesis in lecture 13 of Plant Science for Pacific Islands.




iii. ABSORPTION SPECTRUM

SA

Lab experiment on chlorophyll extraction.

2. **What factors affect the degree of insolation reaching different locations?**

   a. The equator is zero degrees latitude.

b. DAY LENGTH

## The Effect of Latitude and Season on Daylength

| *Latitude, °N* | *Mar 21* | *June 21* | *Sept 21* | *Dec 21* |
|---|---|---|---|---|
| 0 | 12 hours | 12 hours | 12 hours | 12 hours |
| 10 | 12 hours | 12 h, 35 min | 12 hours | 11 h, 25 min |
| 20 | 12 hours | 13 h, 12 min | 12 hours | 10 h, 48 min |
| 30 | 12 hours | 13 h, 56 min | 12 hours | 10 h, 4 min |
| 40 | 12 hours | 14 h, 52 min | 12 hours | 9 h, 8 min |
| 50 | 12 hours | 16 h, 18 min | 12 hours | 7h, 42 min |
| 60 | 12 hours | 18 h, 27 min | 12 hours | 5h, 33 min |
| 70 | 12 hours | Two months | 12 hours | No daylight |
| 80 | 12 hours | Four months | 12 hours | No daylight |
| 90 | 12 hours | Six months | 12 hours | No daylight |

3. **How does light affects plants?**

a. Photosynthesis


Lab experiment on seedling growth

b. PHOTOPERIODISM

i.

ii.

c. ETIOLATION

d. PHOTOTROPISM

4. **How have plants adapted to different light conditions?**

a. C3, C4 and CAM plants.

b. Sun Plants and Shade Plants

5. **How can crops be manipulated to optimize light interception ?**

a. Determine the best CROP DENSITY.

i.

ii.

## Determining crop density

$$\text{Crop density} = \frac{\text{Total Area}}{(\text{Distance between rows}) \cdot (\text{Distance between plants})}$$

For example, what is the crop density per hectare if the crop is planted with 80cm between each row and 25cm between each plant?

$$\frac{10{,}000\text{m}^2\ (1\text{Ha})}{.8\text{m} \cdot .25\text{m}} = \frac{10{,}000\text{m}^2\ (1\text{Ha})}{.2\text{m}^2} = 50{,}000 \text{ plants per hectare}$$

It is best to use the metric system when computing crop density with this formula

SA

Lab on metric equations

b. Eliminate light competition wherever possible

i.

ii.

SA

Lab on tree pruning

c. Establish the canopy fast to shade out weeds.

i.

ii.

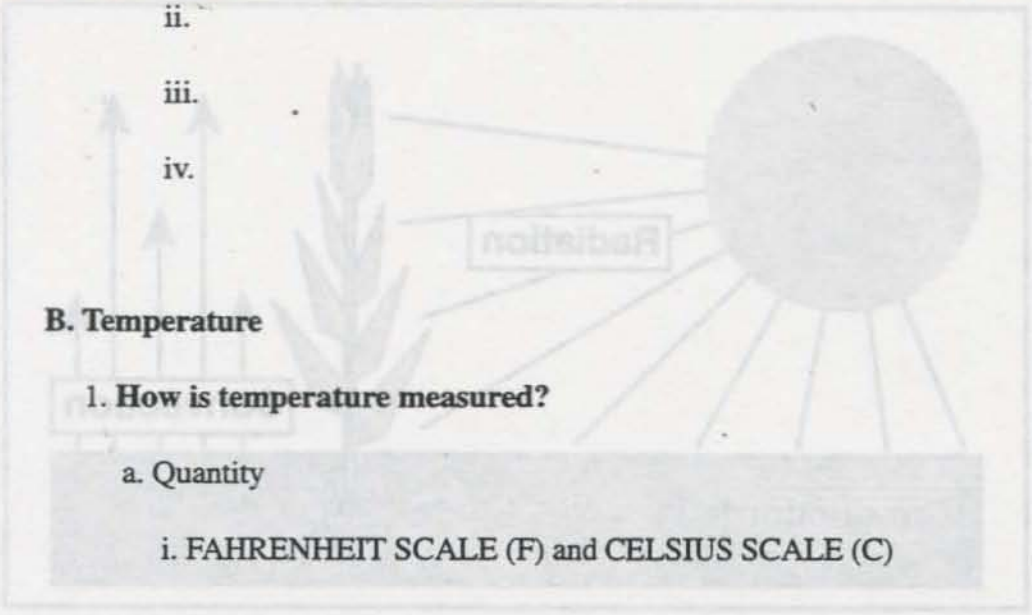
d. Match the crop to the light conditions available.

i.

ii.

iii.

iv.



**B. Temperature**

1. **How is temperature measured?**

a. Quantity

i. FAHRENHEIT SCALE (F) and CELSIUS SCALE (C)

| Converting temperatures between the Celsius and Fahrenheit systems |
| --- |
| ° Fahrenheit= 9/5 °C+32<br>° Celsius= 5/9 (°F-32) |


Lab exercise on temperature conversions

ii. CALORIES (cal) and BRITISH THERMAL UNITS (BTU)

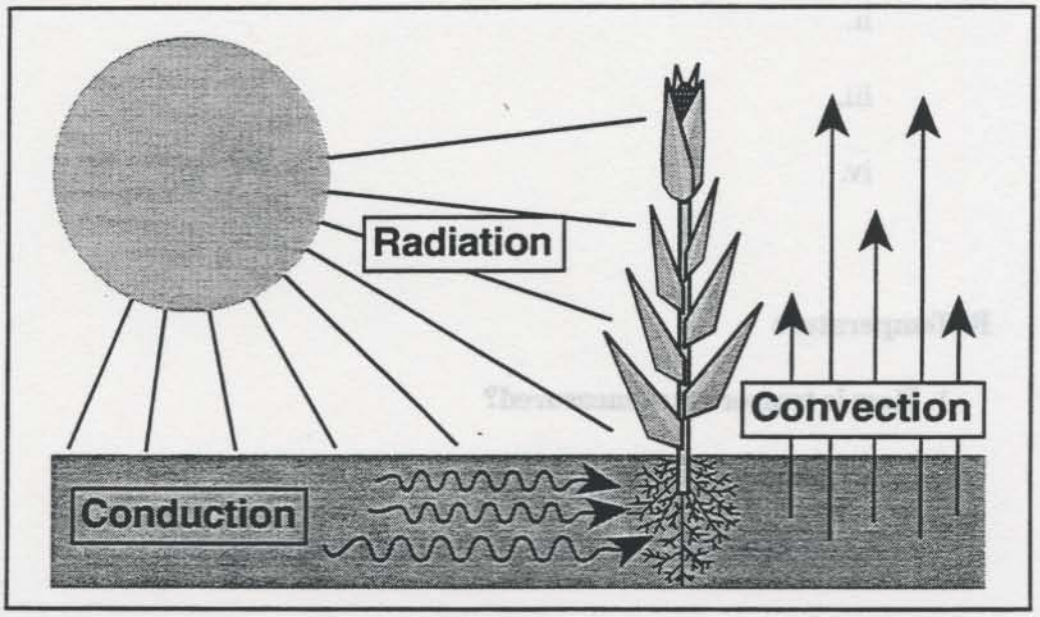
b. Quality

The transfer of heat can occur by three different processes:

RADIATION

CONDUCTION

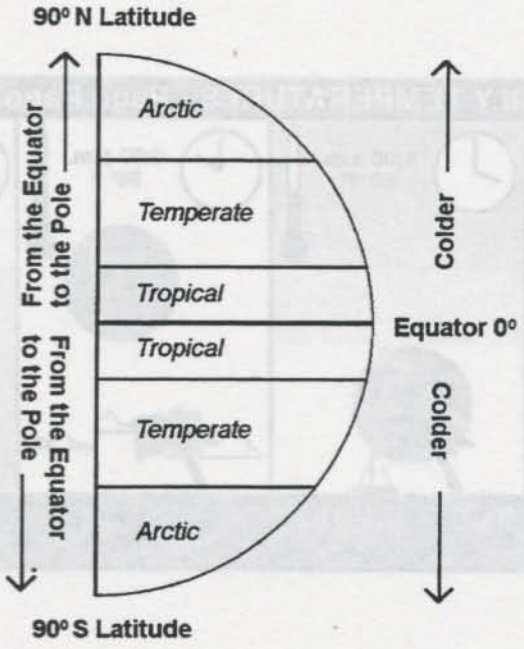
CONVECTION



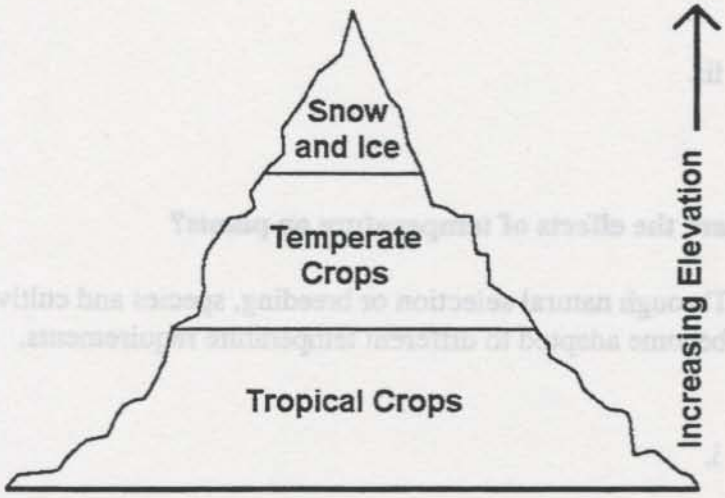

**2. What factors affect temperatures in different locations?**

a. The rotation of the Earth around the sun creates seasonal patterns.

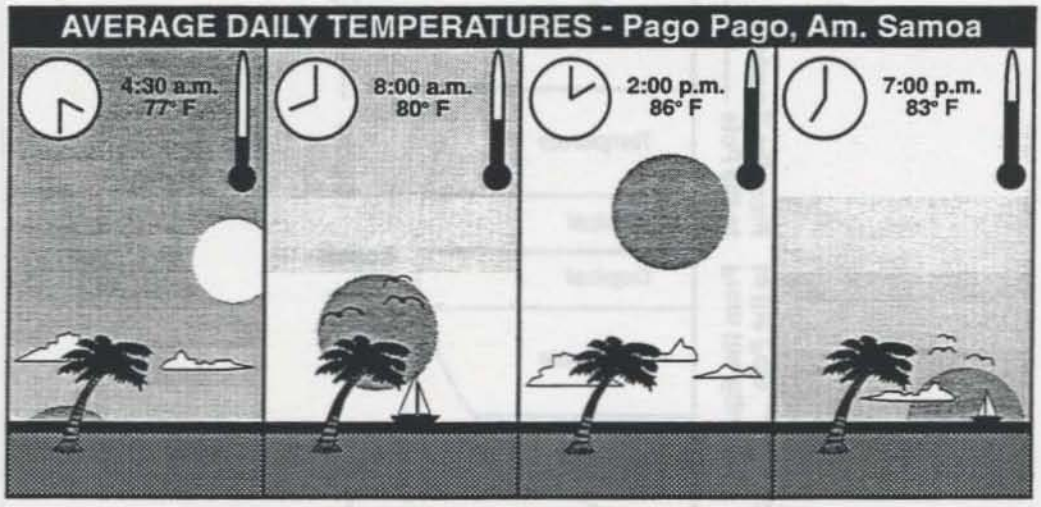
b. The average annual temperatures are higher closer to the equator.




c. Temperature decreases with altitude, irrespective of latitude.



d. The time of day affects temperature at any given moment.




e. Other factors:

i.

ii.

iii.

3. **What are the effects of temperature on plants?**

a. Through natural selection or breeding, species and cultivars have become adapted to different temperature requirements.

i.

ii.

iii.

b. Cooler temperatures are sometimes needed to trigger certain responses in plants.

i. CHILLING REQUIREMENT

ii. VERNALIZATION

iii. STRATIFICATION

iv. THERMOPERIODISM

c. How plants deal with high temperature stress.

i. Evaporation

ii. Reflection of light

iii. LEAF ORIENTATION

## C. Precipitation and Water.

### 1. How is precipitation measured?

a. Quantity

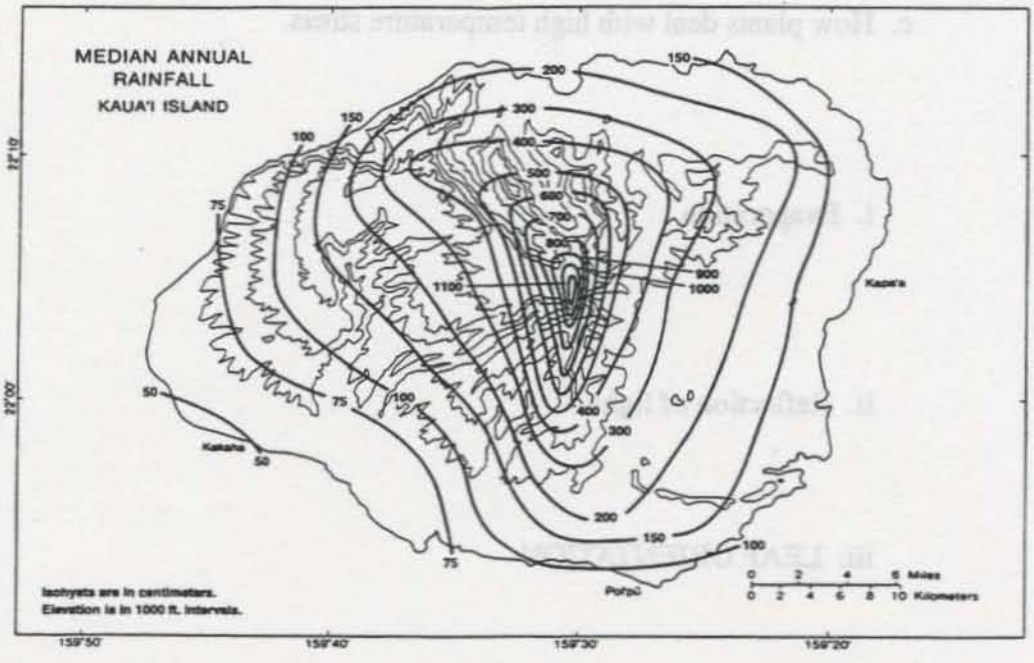
SA

Activity: Field trip to a local weather station.

Lab Exercises-
•Use a rain gauge
•Study condensation
•Measure humidity
•Plot annual and monthly precipitation for different locations

i. Annual Precipitation.

The island of Kauai has one of the wettest places on Earth, Mount Waialale receives 1184 centimeters of rain per year. The coastline on the opposite side of the island receives only 56 centimeters of precipitation annually .




ii. Monthly Precipitation

iii. Rate of Precipitation

iv. Humidity

2. **What factors affect precipitation at different locations?**

a. Temperature

b. Mountains

c. Other weather patterns

3. **How does water affect plants?**

a. Part of all cells and tissues

Review translocation in lecture 12 of Plant Science for Pacific Islands.

b. Solvent for soil nutrients

c. Medium for transportation

d. Chemical reactant

e. Coolant in evapotranspiration

f. Turgor, cell expansion, and stomate operations

g. Water stress can shut down processes and cause growth disorders.

4. **How does the soil affect water availability?**

a. Infiltration

b. WATER POTENTIAL

c. Soil particles in direct contact with water hold it tightly.

5. **What factors affect transpiration?**

a. Insolation

b. Temperature

c. Soil water availability

d. Relative humidity

e. Air movement

f. Plant adaptations

5. **How have plants adapted to different precipitation conditions?**

   a. Limited water conditions

      i.

      ii.

      iii.

      iv.

      v.

      vi.

   b. High Precipitation Conditions.

      i.

      ii.

      iii.

6. **What are the effects of high precipitation on crop production?**

   a. SOIL EROSION

   b. Soil nutrients are leached

   c. Waterlogged soils

   d. Fungus and disease problems

   e. Pollination and Fruit Development

7. **What crop production practices can optimize plant growth under different precipitation conditions?**

a. Greenhouse coverings

b. IRRIGATION

c. MULCH and Organic Matter

d. Plant seasonally

e. Split applications of fertilizer

f. Use fungicides or fungus resistant varieties

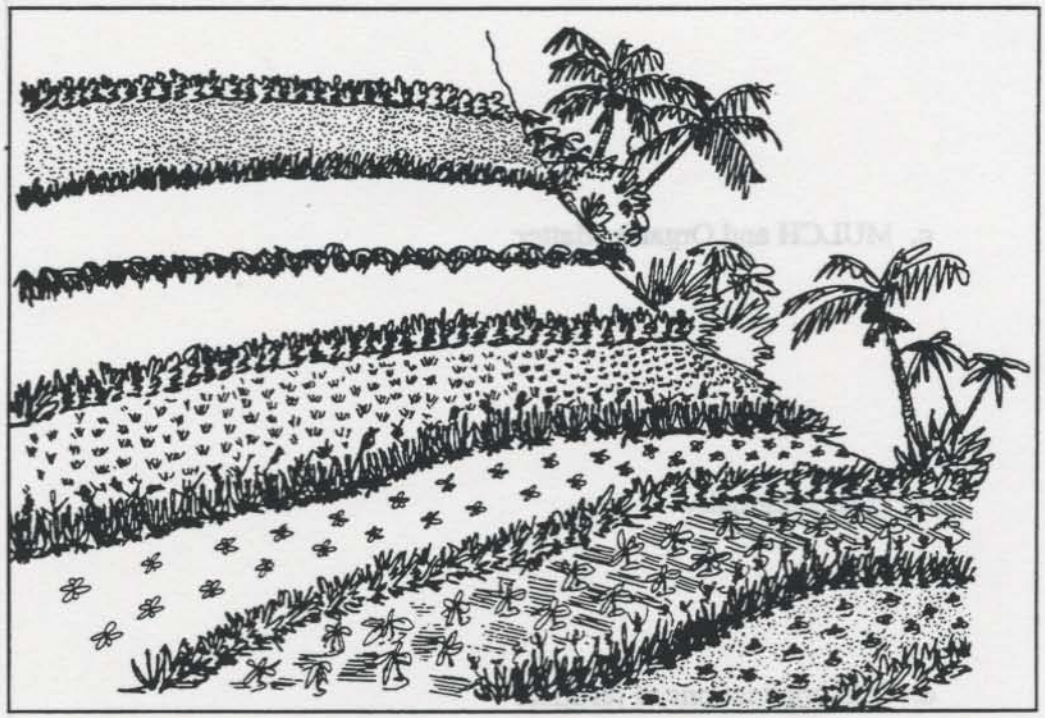
g. HARDEN OFF transplants

h. SOIL CONSERVATION

i. CONTOUR PLANTING

ii. Contour hedgerows

iii. Grassed waterways



**D. Air Movement**

1. **How is air movement measured?**

a. Quantity

i. Wind is measured by speed.

ii. TRADE WINDS

iii. CONVERGENCE ZONES

iv. Strong wind conditions

- Tropical depression with winds above 30 mph.
- Tropical storm with winds above 40 mph.
- Hurricane, cyclone or typhoon with winds above 75 mph.

v. Location


b. Quality

i. $CO_2$ content

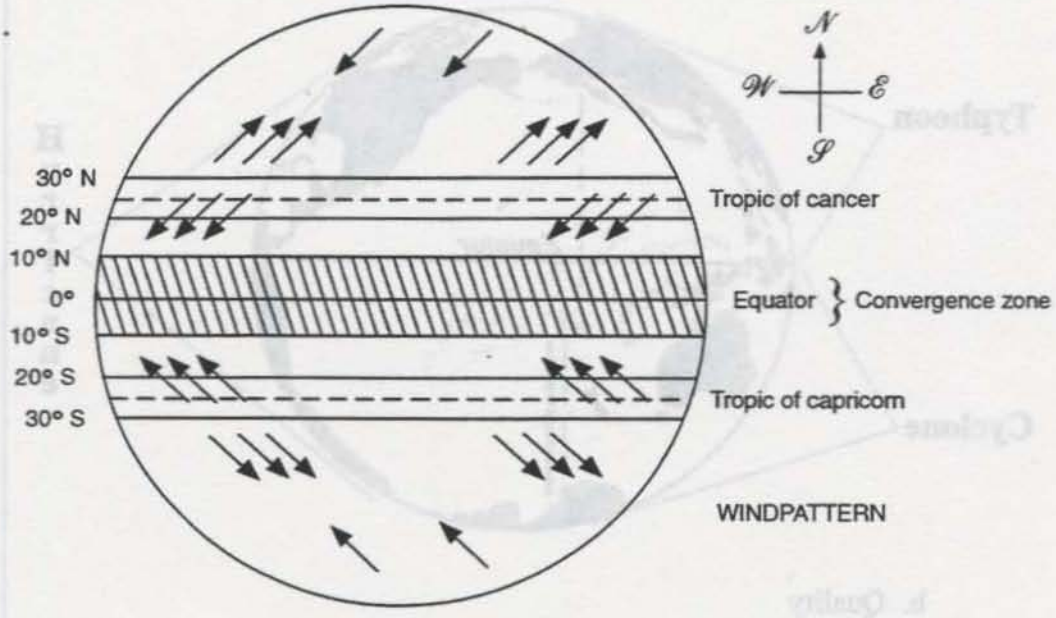
ii. Salt content

iii. Pollutants.

2. **What factors affect air movement?**

a. Wind patterns

i. Solar radiation




ii. Rotation of the planet from west to east.

iii. Seasonal changes

iv. Other factors which create local air patterns.

**3. How have plants adapted to different air conditions?**

a. Wind quantity

i.

ii.

b. Wind quality

**4. What are the effects of air movement on crop production?**

a. Pollination

b. Wind damage

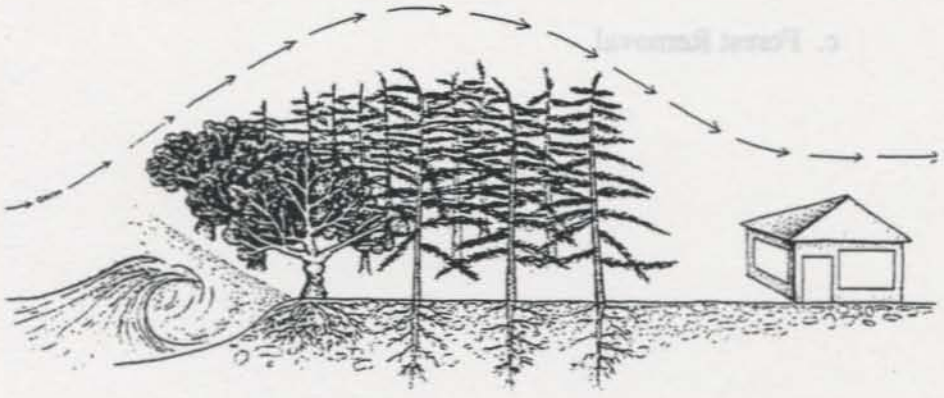
c. Erosion

**5. How can plants be used to optimize cropping in windy conditions?**

a. WINDBREAKS

i. Salt and pollution tolerant species

ii. Roots of windbreak plants can help control erosion.



## E. Global Climate Change

1.

2.

3.

4. Three factors are considered major contributors to global warming:

a. Increased $CO_2$ in the atmosphere magnifies the GREENHOUSE EFFECT.

b. Ozone depletion

c. Forest Removal

# Introduction to World Food Crops

## Performance Objectives

Upon completion of this chapter each student should be able to:

A. Define the 32 terms related to world food crops.

B. Explain three reasons plant classification is important.

C. Name and describe five artificial methods of crop classification.

D. Describe six ways of classifying plants by ecological or climatic requirements.

E. List at least six "common use" categories of crop plants and give two local examples from each category.

F. List the seven taxa of phylogenetic classification in proper descending order.

G. List at least six important families of crop plants and give examples of local crops in each family.

H. Match the scientific names of at least six important local crops with their cultivar and/or common name.

I. Describe the process of identifying an unknown plant.

J. Describe at least five important periods in the timeline of agriculture.

K. List the fifteen crops that provide the majority of the world's food crops and place them into five categories.

L. Explain how physical resources, technology, and information affect crop production in different regions of the world.

M. List the six steps in the scientific method.

N. Name and describe at least two current trends in crop improvement, production methods, and agricultural engineering

# Terms

ACRE (ac)- A unit for measuring land equal to 43,560 square ft., or 1/640 of a square mile.

ANNUAL PLANTS- Plants that live for one year, or one growing season.

ARABLE LAND- Land suitable for farming which can be utilized for growing crops.

ARTIFICIAL CLASSIFICATION- Classification system developed for convenience and based on use, cultural requirements, or other superficial characteristics rather than relationships between plants.

BIENNIAL PLANTS- Plants that live for two years.

BINOMIAL NOMENCLATURE- The scientific name of a plant, consisting of genus and species names.

BIOTECHNOLOGY- The application of molecular biology and genetic engineering to agriculture, industry and medicine.

CULTIVAR- A cultivated variety.

DOMESTICATION- The process of bringing a wild species into human management.

FEED CROPS- Crops that are produced for consumption by livestock.

FERTILIZER EFFICIENCY- The measure of the conversion of fertilizer into harvested crops.

FIBER CROPS- Crops produced to create raw materials for textiles, cordage, and building products.

FOOD CROPS- Crops produced for human consumption.

HECTARE (ha)- A land area of 10,000 meters$^2$, equal to about 2.5 acres.

HERBARIUM- A collection of dried plant specimens.

HYDROPONICS- Growing plants in water and/or a soil-less media while providing all the essential nutrients.

INDUSTRIAL CROPS- Crops that are grown for a wide variety of products, extracts, and derivatives.

INTEGRATED PEST MANAGEMENT- A combination of biological, cultural, and mechanical pest control practices with chemicals used as a last alternative.

IRRIGATION- The application of water to land for the production of crops.

MECHANICAL HARVESTERS - Equipment that has greatly reduced the labor needed to harvest crops, (eg., cotton gin, combine, and tomato pickers).

OIL CROPS- Plants grown to produce lipids for human or animal consumption, or industrial purposes.

ORNAMENTAL CROPS- Plants grown for use in landscaping and decoration.

PERENNIAL PLANTS- Plants which live from several to many years.

PHYLOGENETIC CLASSIFICATION- A system that classifies plants according to their apparent evolutionary relationship.

PLANT CLASSIFICATION- A continuously evolving system of grouping plants according to their relationships to each other.

PLANT IDENTIFICATION- The process for determining the identity of an unknown plant.

PLANT MORPHOLOGY- The study of a plant's external shape and form.

POST HARVEST TECHNOLOGIES- New methods to handle, preserve, transport, and store crops after removal from the field.

SELECTION- The process of controlled reproduction of a domesticated species.

TAXONOMY- The study of plant classification.

TISSUE CULTURE- Growing masses of unorganized cells for rapid asexual multiplication of plants.

VARIETY- A named group of plants within a species which can be identified by a set group of characteristics.

# I. Classification of Crop Plants

**A. TAXONOMY is the study of PLANT CLASSIFICATION.**

1. **What is the importance of classifying plants?**

a.

b.

c.

**B. Plant classification systems**

1. **What are the two basic classification systems?**

a. ARTIFICIAL CLASSIFICATION

b. PHYLOGENETIC CLASSIFICATION

2. **What are five methods of artificial classification?**

a. Useful vs. harmful plants

i.

ii.

b. Life span or growth patterns

i. ANNUAL PLANTS

ii. BIENNIAL PLANTS

iii. PERENNIAL PLANTS

c. Ecological or climatic requirements

i. Moisture

ii. Temperature

iii. Climate

iv. Stress tolerance

v. Photoperiod

vi. Light intensity

d. PLANT MORPHOLOGY

i. Leaf retention

ii. Broad leaf trees vs. needle leaf trees.

iii. Broadleaf vs. grass

iv. Woody vs. herbaceous

e. Common usage

Discuss other local crops that fit into the common use system.

i. FOOD CROPS

ii. FEED CROPS

iii. FIBER CROPS

iv. OIL CROPS

v. ORNAMENTAL CROPS

vi. INDUSTRIAL CROPS

3. **How does the phylogenetic system classify crops?**

a. Evolutionary relationships

b. Reproductive (flower) parts

c. TAXA are the units of classification

Kingdom
Division
Class
Order
Family
Genus
Species

d. VARIETY and CULTIVAR


Create lists of local cultivars of important traditional crops.

e. Development of the phylogenetic system

i. Linnaeus, the "father of taxonomy" wrote Species Plantarum.

ii. Darwin published the Origin of Species in 1859.

f. BINOMIAL NOMENCLATURE


Interested students can research how one or more of the new scientific techniques is used in plant taxonomy.

i.

ii.

iii.

g. Major families of crop plants

Araceae

Bromeliaceae

Chenopodiaceae

Convolvulaceae

Cruciferae

Cucurbitaceae

Euphorbiaceae

Graminae (Poaceae)

Leguminosae (Fabaceae)

Musaceae

Palmae

Rutaceae

Rosaceae

Solanaceae

Umbrelliferae

Review objectives G. and H. for this chapter.

Study the taxonomic families of local crops.

Create a list of local cultivars of important traditional crops

Develop the full classification from Kingdom to Species for selected crops.

h. Examples of classification for specific crop plants:

**Taro**

| | | |
|---|---|---|
| Kingdom | Plantae | |
| Division | Spermatophyta | (seed bearing) |
| Class | Angiospermae | (seed in fruit) |
| Sub-class | Monocotyledonae | (single seed leaf) |
| Order | Arales | |
| Family | Araceae | |
| Genus | Colocasia | |
| Species | Esculenta | |
| Cultivar | 'Alafua Sunrise' | |

**Head cabbage**

| | | |
|---|---|---|
| Class | Angiospermae | |
| Subclass | Dicotyledonae | (two seed leaves) |
| Order | Papaverales | |
| Family | Cruciferae | |
| Genus | Brassica | |
| Species | Oleracea | |
| Variety | Capitata | |
| Cultivar | 'Golden Acres' | |

**Pfitzer Juniper**

| | | |
|---|---|---|
| Class | Gymnospermae | (seed not in fruits) |
| Order | Coniferales | |
| Family | Cupressaseae | |
| Subfamily | Cupressoideae | |
| Tribe | Juniperae | |
| Genus | Juniperus | |
| Species | Chinensis | |
| Cultivar | 'Aurea' or 'Golden Pfitzer Juniper' | |

5. **How are classification systems used for plant identification?**

Steps in plant identification

- Develop a knowledge of the vocabulary of plant morphology.
- Obtain keys, plant manuals, floras and other references which describe plants of a given region, or of a particular family or genus.
- Visit herbaria. A HERBARIUM is a collection of dried plant specimens.
- Compare with herbarium specimens, or with living specimens, usually contained in botanical gardens.
- Seek a known authority (e.g. Hortus Third or Flora of Hawaii).
- Ask a taxonomist or other knowledgeable person for assistance. Obtain permission to send plant specimens to a taxonomist.

# II. Development of Crop Production

## A. Timeline of agriculture

| | |
|---|---|
| 5,000,000,000 years ago | Earth formed |
| 300,000,000 years ago | Earliest dinosaurs |
| 4,000,000 years ago | Earliest humans, food gatherers and hunters. |
| 12,000 years ago | Last glaciers begin retreat. |
| 10,000 years ago | Neolithic revolution: people began to domesticate plants and settle into villages (began in Middle East, Iraq/Egypt). |
| 8,000 years ago | People in Southeast Asia and Latin America began farming. |
| 6,000 years ago | People in Central Africa and China began farming. |
| 500 years ago | Age of Exploration: Ships travelled all over the world in search of spices, gold and converts. Brought back plants and crops from other parts. |
| 250 years ago | Industrial Revolution: Farmers in England began using new breeding techniques. Increased food production released labor from the farms to work in factories. New sources of energy and technological advances lead to rapid changes and higher outputs in agriculture. |
| 40 years ago | Green Revolution: Increased use of science to solve agricultural problems lead to adoption of new varieties, chemical pesticides and fertilizers, and increased mechanization throughout the world; with many successes and some failures. (Rockefeller foundation set up the international research centers.) |
| 1970s to present | Environmental Revolution: Increased concern about effects of the Industrial and Green Revolution on Earth's environment. Move toward organic lifestyles, appropriate technologies, and sustainable development systems. |

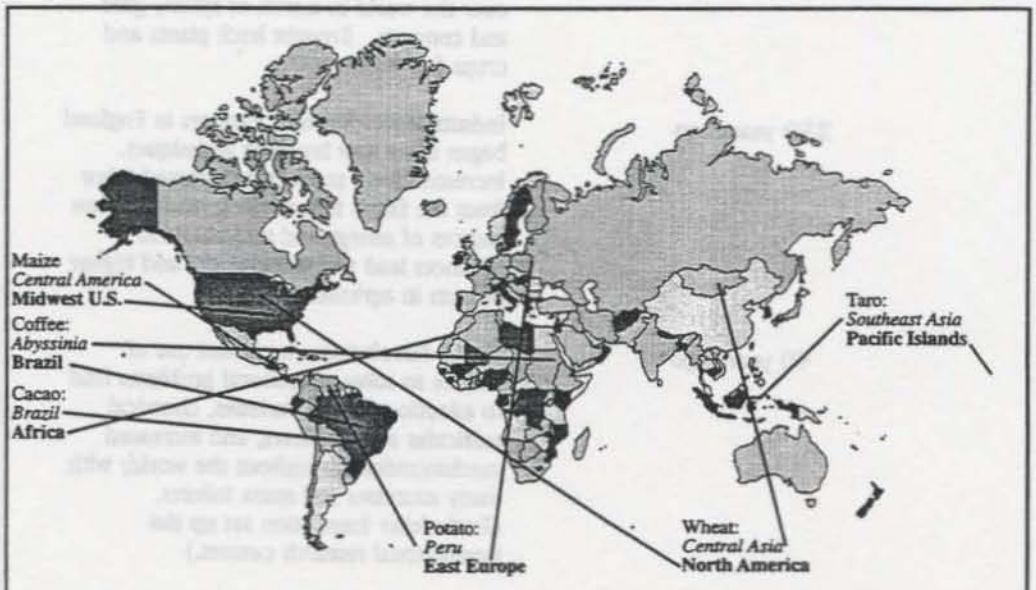
**B. Crop production throughout the world.**

1. **How were crops developed?**

a. DOMESTICATION

b. SELECTION

2. **How were crops spread from their original locations?**




Centers of origin are *italicized*. Centers of modern production are **boldfaced**.

3. **What are the major food crops of the world?**

| Cereals | "Root" Crops | Legumes | Sugar Crops | Tropical Crops |
|---|---|---|---|---|
| Rice | Potato | Beans | Sugarcane | Banana |
| Wheat | Sweet Potato | Soybean | Sugar Beet | Coconut |
| Corn | Cassava | Peanut | | |
| Sohrgum | | | | |
| Barley | | | | |

4. **Which crops are produced in the greatest amounts worldwide?**

| Crop | Leading Producer |
|---|---|
| Rice | Asia |
| Wheat | Russia |
| Corn | United States |
| Potato | Europe |

5. **How does the availability of resources affect crop production in different regions of the world?**

a. Climate and physical resources.

| Tropical | Temperate |
|---|---|
| Year around warm growing season | Short growing season |
| Nutrient poor soils | Nutrient rich soils |
| More pest and disease problems | Pest/disease control - Winter |

b. Technology and information

Countries are ranked from one (the most amount) to seven (the least amount) on various factors that affect food crop production.

| | North America | Europe | Africa | Russia | China | Asia | South America |
|---|---|---|---|---|---|---|---|
| % of workers in agriculture | <5% 5 | 10% 4 | 60% 1 | 20% 3 | 60% 1 | 60% 1 | 40% 2 |
| Acres[1] of arable[2] land per worker | 1 | 3 | 5 | 2 | 7 | 6 | 4 |
| % of arable land in production | 58% 4 | 81% 1 | 25% 5 | 65% 3 | ? | 72% 2 | 19% 6 |
| Mechanization #tractors/acre | 2 | 1 | 6 | 3 | 4 | 6 | 5 |
| Land under Irrigation[3] | 3 | 3 | 4 | 3 | 1 | 2 | 3 |
| Fertilizer use/ hectare[4] arable land | 3 | 1 | 6 | 4 | ? | 2 | 5 |
| Harvest in tons/ hectare arable land | 3 | 1 | 5 | 4 | ? | 2 | 4 |
| Fertilizer Efficiency[5] | 2 | 5 | 1 | 4 | 3 | 3 | ? |

Footnotes:

1.ACRE (ac) is a unit for measuring land equal to 43,560 square ft., or 1/640 of a square mile (about the size of a football field).

3.HECTARE (ha) is a land area equal to about 2.5 acres.

2. ARABLE LAND is land suitable for farming which can be utilized for growing crops.

4. IRRIGATION is the application of water to land for the production of crops.

5. FERTILIZER EFFICIENCY is the measure of the conversion of fertilizer into harvested crops.

*In the examples from this table, dividing the kilograms of fertilizer per hectare into the tons of harvest per hectare gives the fertilizer efficiency. However, other energy inputs are involved such as mechanization and irrigation.*

c. Generalizations drawn from the table on the previous page

i. North America

ii. Europe

iii. Africa and Asia

d. The combined climate, physical resources, technology, and information systems in the United States result in the ability of the Midwestern farmer to produce as much corn on one hectare as can be produced on 10 hectares in Africa or South America

e. Use of improved varieties and cropping practices can also make a huge difference in yields amongst farmers in the United States.

## Effect of inputs on crop yield

| Crop | Average yield* | Record yield* |
|---|---|---|
| Corn | 72 | 307 |
| Wheat | 28 | 216 |
| Soybeans | 45 | 110 |
| Potatoes | 420 | 1400 |

*Measured in bushels per acre

6. **How has applied scientific research improved crop production?**

a. Crop production has been a form of applied science from the first efforts at plant domestication.

b. Six steps in the scientific method

i.

ii.

iii.

iv.

v.

vi.

c. Some early scientists and their agriculturally related discoveries:

i. Robert Hooke (1935-1703)
ii. Carl von Linne (1707-1778)
iii. Joseph Koelreuter (1733-1806)
iv. Gregor Mendel (1822-1884)

d. Beginnings of agriculture sciences:

i. Justis von Liebig (1803-1873)
ii. Louis Pasteur (1822-1895)
iii. John Bennet Lawes (1814-1901)

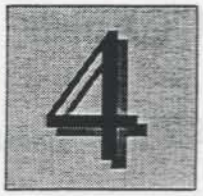
e. Recent improvements and current trends

i. Crop Improvement

ii. Production Methods

iii. Agricultural Engineering

# Production of Major World Food Crops




## Performance Objectives

Upon completion of this chapter each student should be able to:

A. Define the 18 terms related to the production of major world food crops.

B. Identify the scientific names of the major world food crops.

C. Explain seven reasons why cereals are important to world food crop production.

D. Describe the locations and conditions of world rice production.

E. Describe at least two characteristics of long grain, medium grain, and short grain rice.

F. Explain the different rice production methods in at least three specific parts of the world.

G. Describe the locations and conditions of world corn production.

H. Describe five different types of corn.

I. Explain the different corn production methods used by primitive and modern cultures.

J. Describe the locations and conditions of world wheat production.

K. Explain three differences between hard wheat and soft wheat.

L. Describe at least two practices in each of the four regional wheat production methods described.

M. Explain two reasons why legumes may be the most important world food crops.

N. Describe the locations and conditions of world soybean production.

O. Describe the cultural practices of mechanized soybean production.

P. Explain the uses of soybeans and other legumes by developed and less developed countries.

Q. Describe the locations and conditions of world peanut production.

R. Describe how peanuts are grown and harvested.

# Chapter 4 objectives, continued

S. Describe six growth characteristics of sugarcane.

T. Explain the steps in the cultivation and processing of sugarcane

U. Describe the steps in selecting the best coconut seed for propagation.

V. Describe the seven steps in managing a coconut nursery.

W. Explain two methods of spacing seedling trees in a coconut plantation

# Terms

BAGASSE- The fibrous residue of sugar cane stems.

CEREALS- Crop plants that are members the Graminae family.

COMBINE- A farm machine that harvests, threshes, and cleans grains and legumes while moving over the field.

DOUBLE CROPPING- The practice of producing two crops on one piece of land during separate growing seasons within the same year.

GRAIN- The fruit of a cereal plant which has an ovary wall that turns hard and fuses with a single seed.

GREEN MANURE- A crop grown for the purpose of improving the soil on a piece of land that will be used for growing other crops.

INTERCROPPING- The practice of growing more than one crop on one piece of land at the same time.

LEGUMES- The fruit and/or seed from plants in the Leguminosae family.

LODGING- The failure of a plant stem to bear the weight of the top of the plant.

NITROGEN FIXATION- The biological conversion of elemental Nitrogen ($N_2$) into organic combinations usable by living things.

PADDY FIELD- A heavily irrigated or lightly flooded piece of land where crops are grown in standing water.

PEGGING- The growth of the peanut flower pedicel which pushes it below the soil.

RATOON- The regrowth of a plant from its crown or stem.

PREEMERGENCE HERBICIDE- A form of weed killer that controls plant growth before the crop seedlings appear above the soil surface.

RUST DISEASE- A fungal problem of wheat that greatly reduces yield.

SYMBIOSIS- The condition that exists when two species live closely together and both benefit from the association.

THRESHING- The removal of mature grain from a dry cereal plant.

ZERO TILLAGE- A practice that uses specialized equipment to control weeds, plant seed, and fertilize those seeds without major disturbance or cultivation of the soil surface in the entire field.

# I. Cereals

## A. Introduction

CEREALS are crop plants that are members of the grass (Graminae) family.The primary cereal crops are rice, corn, and wheat.

GRAIN is the fruit of a cereal plant which has an ovary wall that turns hard and fuses with a single seed.

1. **Why are cereals so important to world crop production?**

## B. Rice (Oryza sativa)

Rice is the major staple food for 60 percent of the world's population. It has been domesticated and grown in China for more than 5000 years.

1. **Where is rice usually grown?**

   a. Most of the world's rice crop is grown in the warm, wet climates of tropical Asia.

   b. PADDY FIELDS

2. **What different types of rice are grown?**

## Some varieties of rice

| | |
|---|---|
| **Long Grain** | •needs longest time to reach maturity, grown in tropics<br>•does not turn sticky when cooked<br>•the preferred type in developed countries |
| **Medium Grain** | •shorter growing season than long grain<br>•softer and stickier then long grain<br>•commonly grown in Southeastern U.S. and California |
| **Short Grain** | •shortest growing season, good in temperate climate<br>•soft and sticky, preferred in some Asian countries<br>•commonly grown in Japan |

3. **How do the methods of rice production vary in different parts of the world?**

a. Thailand

b. Philippine Islands

c. Japan

d. United States of America

## Examples of fertilizer and rice yield data

| Country | Fertilizer (kg/ha) | Yield (tons/ha) |
|---|---|---|
| Thailand | No fertilizer | 1.2 |
| Philippines | 5(N) 5(P) 3(K) | 1.3 |
| Japan | 85(N) 57(P) 62(K) | 4.5 |
| U.S.A. (California) | 140(N) 50(P) * (K) | 5.5 |

* based upon soil tests for deficiency

4. **How are rice grains processed?**

**C. Corn** (Zea mays)

1. **Where is corn grown?**

a. Corn is grown throughout humid, temperate regions of the world.

i. Cross breeding of hybrids

ii. Extra care in planting, fertilization, pest control, and harvesting

2. **What are five different types of corn?**

a. Field corn

b. Other types of corn

3. **How did primitive cultures cultivate corn?**

INTERCROPPING is the practice of growing more than one crop on one piece of land at the same time.

4. **How do modern cultures cultivate corn?**

ZERO TILLAGE uses specialized equipment to control weeds, plant seed, and fertilize those seeds without major disturbance or cultivation of the soil surface in the entire field.

Review fertilizer use in lecture 17 of Plant Science for Pacific Islands

5. **What products are made by processing corn?**

**D. Wheat** (Triticum aestivum)

1. **Where is wheat grown?**

   a. Wheat is adapted to climates that are cold and dry, where many other crops cannot be grown.

   b. Moderate moisture and cool weather for early growth, bright sun for maturing the grain, and a dry period for harvest.

2. **What are the two basic types of wheat?**

   a. Hard Wheat

   b. Soft Wheat

3. **What are some of the regional methods of growing wheat?**

   a. Winter wheat

b. Spring wheat

c. Dryland practices

d. Humid region practices

DOUBLE CROPPING is the practice of producing two crops on one piece of land during separate growing seasons within the same year.

**4. What are some common wheat diseases and problems?**

a. RUST DISEASE

b. LODGING

# II. Legumes

## A. Introduction

Legumes are the fruit and/or seeds from plants in the Leguminosae family. Legumes are the second largest group of crop plants grown worldwide for food production. Although cereal crops are produced in larger amounts, legumes may be more important for two reasons.

1. **What is the importance of the legume family?**

   a. SYMBIOSIS

      i. Bradyrhizobium spp.

      ii. NITROGEN FIXATION

      iii. Field crop with the least dependence on nitrogen fertilizers.

      iv. GREEN MANURE

   b. Crop plants that contain the greatest amount of protein per pound.

**Protein levels of important food crops**

| Food Crop | Protein content |
|---|---|
| Soybean | 42% to 33% |
| Peanut | 30% to 25% |
| Wheat flour | 13.5% to 9.8% |
| Potato | 13% to 10% |
| Corn meal | 9.4% to 7.0% |
| Whole rice | 9.0% to 7.5 |
| Polished rice | 7.6% to 5.2% |
| Cassava | 1.3% to 1.0% |

2. **What are legumes used for?**

**B. Soybean** (Glycine max)

1. **Where are soybeans grown?**

a. Soybeans are adapted to temperate climates with a warm growing season and a moist summer.

b. Soybeans are tolerant of many soil types, but grow best on well drained, heavier soils.

2. **How are soybeans grown?**

PREEMERGENCE HERBICIDE is a weed killer that controls plant growth before the crop seedlings appear above the soil surface.

3. **What are soybeans used for?**

**C. Peanut** (Arachis hypogaea)

1. **Where are peanuts grown?**

a. Peanuts are grown in the tropics, subtropics and warmer climates.

b. The U.S., India, China, and Brazil are leaders in peanut production.

2. **What are the two main types of peanuts?**

a. Virginia peanuts

b. Spanish peanuts

3. **How are peanuts grown?**

PEGGING refers to the growth of the peanut flower pedicel which pushes it below the soil.

# III. Tropical Crops

## A. Introduction

Three of the 15 major field crops in the world require a tropical climate for production. Sugar and Coconut will be described in this section. Banana will be addressed in the next chapter as a case study.

## B. Sugarcane (Saccharum officinarum)

1. **What are the growth characteristics of sugarcane?**

2. **How is sugarcane cultivated and processed?**

RATOON is the regrowth of a plant from its crown or stem, especially sugarcane.

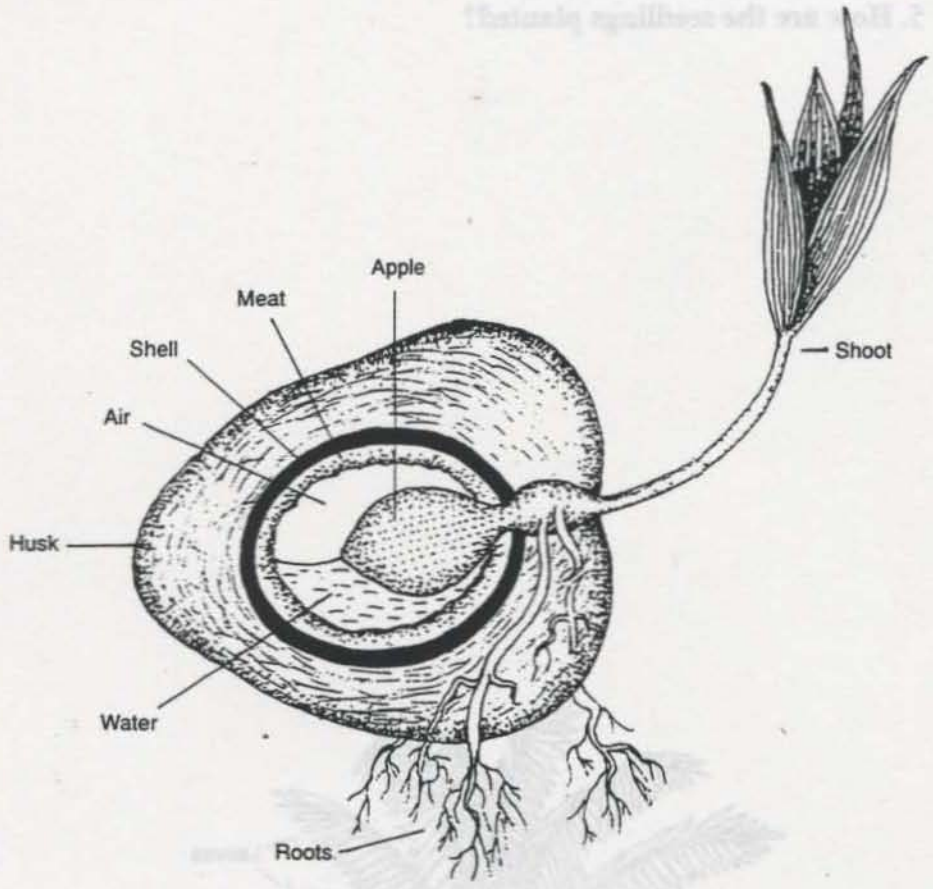
B. **Coconut** (Cocos nucifera)

Coconut trees are long lived plants that will be productive for 60+ years when properly cultivated. Many coconut plantations on Pacific islands are overmature and require reestablishment to obtain maximum yields.

This section will describe the steps in establishing a coconut plantation.

1. **How are the best seeds selected?**

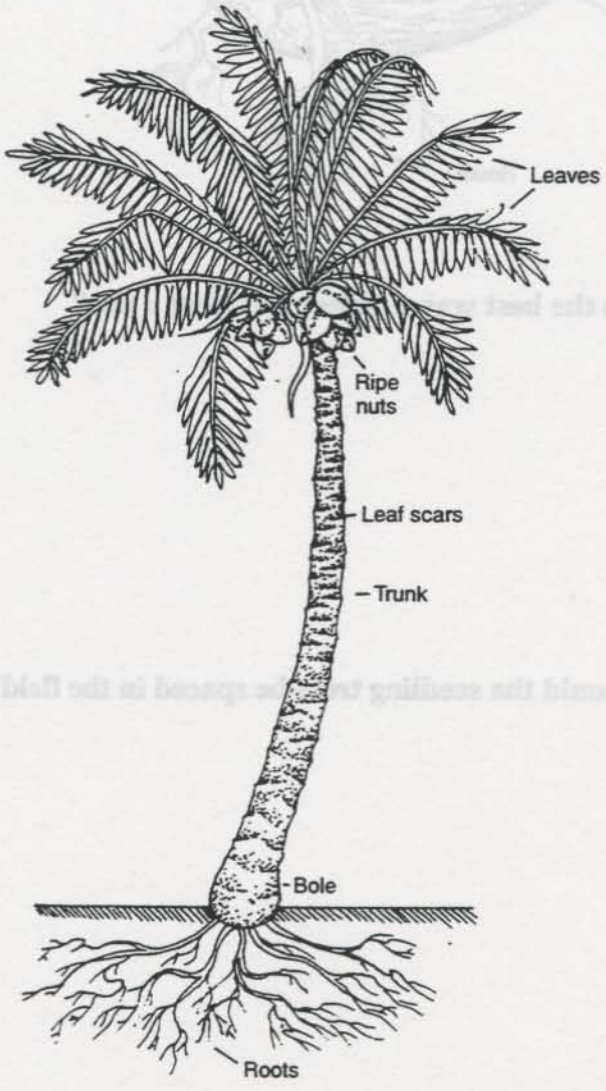
2. **How is a coconut nursery managed?**




3. **What is the best way to select and clear a site?**

4. **How should the seedling trees be spaced in the field?**

5. **How are the seedlings planted?**



# Banana Production: A Case Study

## Performance Objectives

Upon completion of this chapter each student should be able to:

A. Define the 12 terms related to banana production.

B Explain three reasons why bananas are a popular crop for Pacific island farmers.

C. List three reasons why banana roots are different than the roots of most crop plants.

D. Describe the differences between a sword sucker and a water sucker.

E. Identify the six main parts of the flowering stem of a banana plant.

F. Write a brief description for each of the three most important types of bananas.

G. List the seven key points for selecting the best site for a banana plantation.

H. Explain at least four practices used when properly clearing land for a banana plantation.

I. Explain the two main reasons that bananas are planted closer together than most other crop plants.

J. List three factors that affect the spacing of banana plants to optimize available sunlight.

K. List the four steps used to obtain a recommended spacing between banana plants.

L. Explain the recommended practices for controlling weeds in a banana plantation.

M. List three main benefits of a properly fertilized banana plantation.

N. Describe the best complete fertilizer mixture (and time of application) for banana production.

O. Explain two main reasons for desuckering banana plants.

P. Describe the appearance of a correctly desuckered banana plant.

Q. Describe nematodes and the damage they cause to banana plants.

R. Explain the three main ways of controlling nematodes in a banana plantation.

# Chapter 5 objectives, continued

S. Describe weevil borers and the damage they cause to banana plants.

T. Explain three methods of controlling weevil borers in a banana plantation.

U. Describe how leaf spot diseases are caused and name the three important types that damage many banana plants in the Pacific islands.

V. Explain at least six key points about preparing and spraying fungicides to control leaf spot diseases.

W Describe the effects of bunchy top disease and how it is caused.

X. List the two effective ways to control bunchy top disease.

# Terms

BELL- A cone shaped structure at the end of the flowering stem which is made up of the young bracts formed one around the other.

BIT- A large piece of a banana corm, containing at least one active eye or growing point, that is used for planting material.

BRACT- A large leaf-like covering that encloses each group of female and male banana flowers.

CORM- The true stem of a banana plant that forms a hard underground base.

DESUCKERING- The practice of cutting out the unwanted suckers from a banana plant.

FALSE STEM (pseudostem)- The part of a banana plant made of tightly packed leaf sheaths.

FOLLOWER- A large sucker that has not yet fully matured.

MAIDEN- A mature false stem that will soon flower and bear fruit.

PEEPER- A very young sucker with only small leaves.

SUCKER- A young plant that begins as a bud or "eye" growing from the corm.

SWORD SUCKER- A sucker with a strong false stem that is attached to the "mother" plant.

WATER SUCKER- A sucker with a weak false stem that is not attached to the "mother" plant.

# I. Importance and Botany of Bananas

## A. Introduction

Bananas are tropical lowland plants that appear to have originated in southeast Asia.

Bananas are classified in the genus Musa and then into four groups. Each group is composed of cultivars that have botanical and agricultural differences.

1. **Why are bananas important in the Pacific islands**?

   a. A staple food in local diets

   b. Well adapted to the climatic conditions

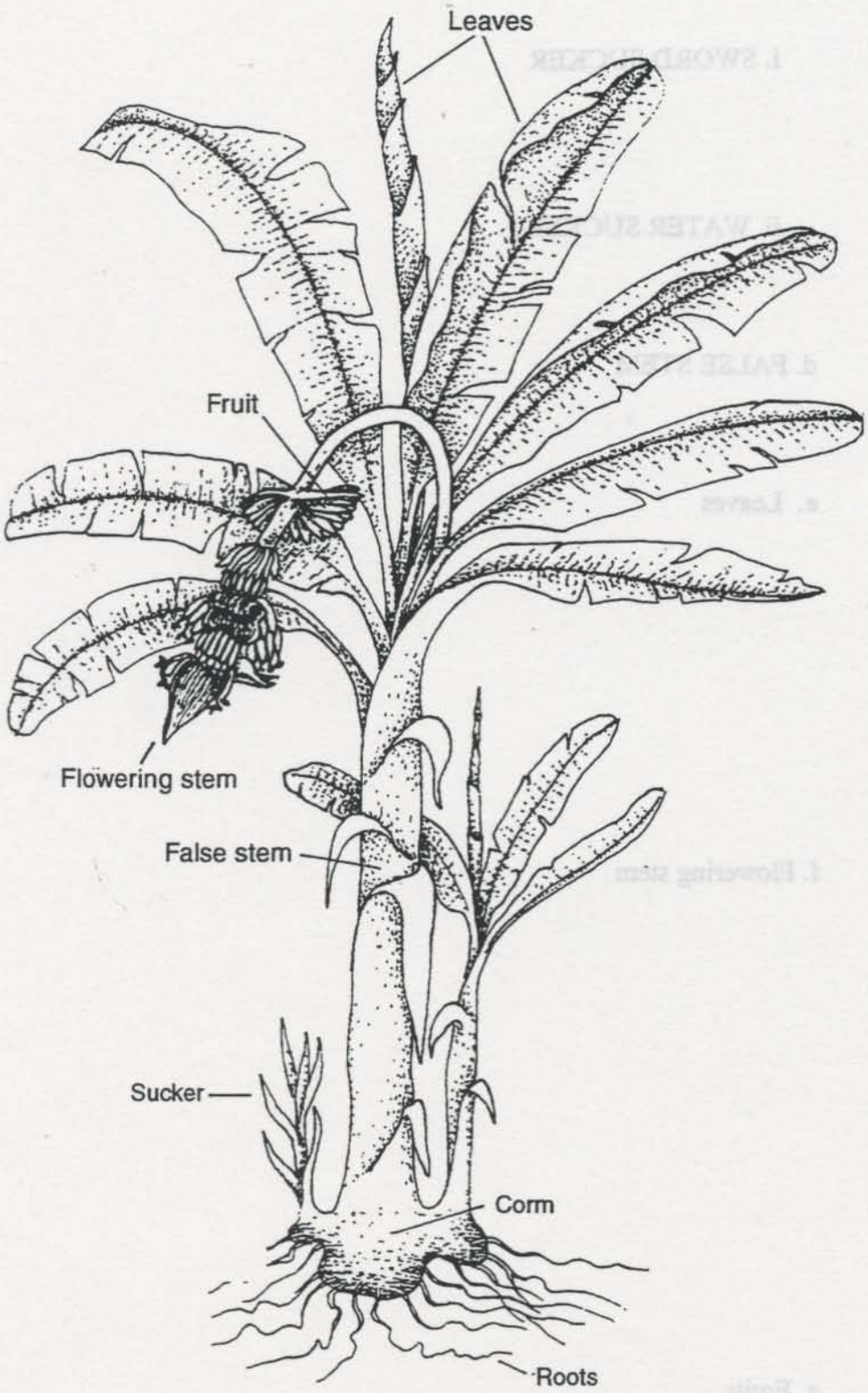
   c. A popular crop with farmers for three main reasons.

## B. Botany

1. **How are bananas different from other crop plants?**

   a. Roots

   b. CORM




Seven main parts of a banana plant

SA

Examine the roots, corm, suckers, false stem, leaves, and flowering stem of a banana plant.

Draw the plant and label all main parts.

c. SUCKER

i. SWORD SUCKER

ii. WATER SUCKER

d. FALSE STEM

e. Leaves

f. Flowering stem

g. Fruits

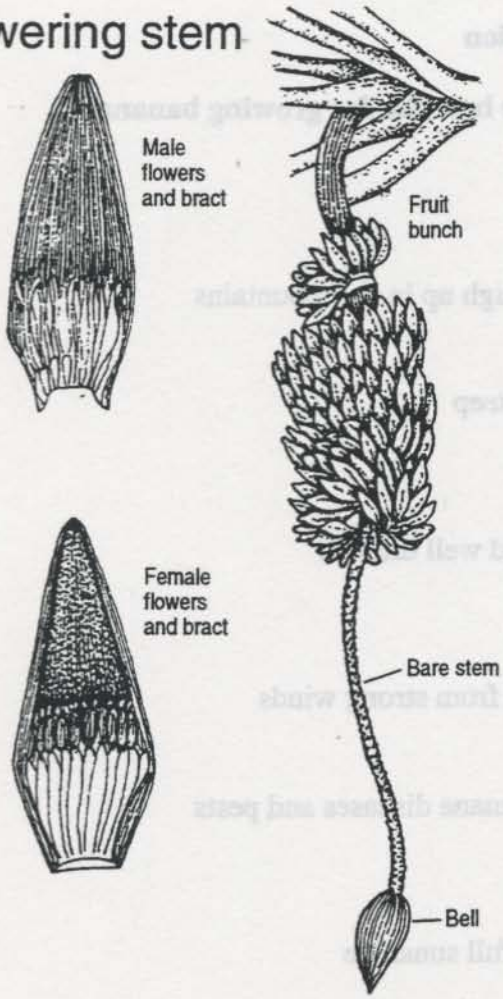
SA

Cut down an old banana plant at the base of the false stem. Look at the cross section to see all the leaf bases wrapped around each other. Pull these apart one at a time.

Dig up a corm and its suckers to see how they grow. Identify the sword and water suckers.

Count the number of green leaves on a few healthy banana plants. Observe the newest and oldest leaves.

## The flowering stem




2. **What are three important banana cultivars for Pacific islands?**

a Cavendish banana, 'Robusta' syn. 'Poyo', (AAA Group)

b. 'Mysore' banana, (AAB Group)

c. 'Bluggoe' bananas (ABB Group)

SA

Look at a hand of fruit from each type.

A small planting of each type might be started on the school grounds

# II. Banana Production

## A. Site Preparation

1. **What is the best site for growing bananas?**

Discuss and study different local areas to decide if each site would be good for a banana plantation.

a. Not too high up in the mountains

b. Not too steep

c. Fertile and well drained

d. Protected from strong winds

e. Free of banana diseases and pests

f. Receives full sunshine

g. Close to a road

2. **What is the best way to clear a plot for banana planting?**

a. End of the dry season

b. Large trees

c. Old banana plantations

d. Light bush

e. Never bulldoze land

**B. Crop Establishment.**

1. **How is high quality planting material selected?**

a. Disease and insect free plants

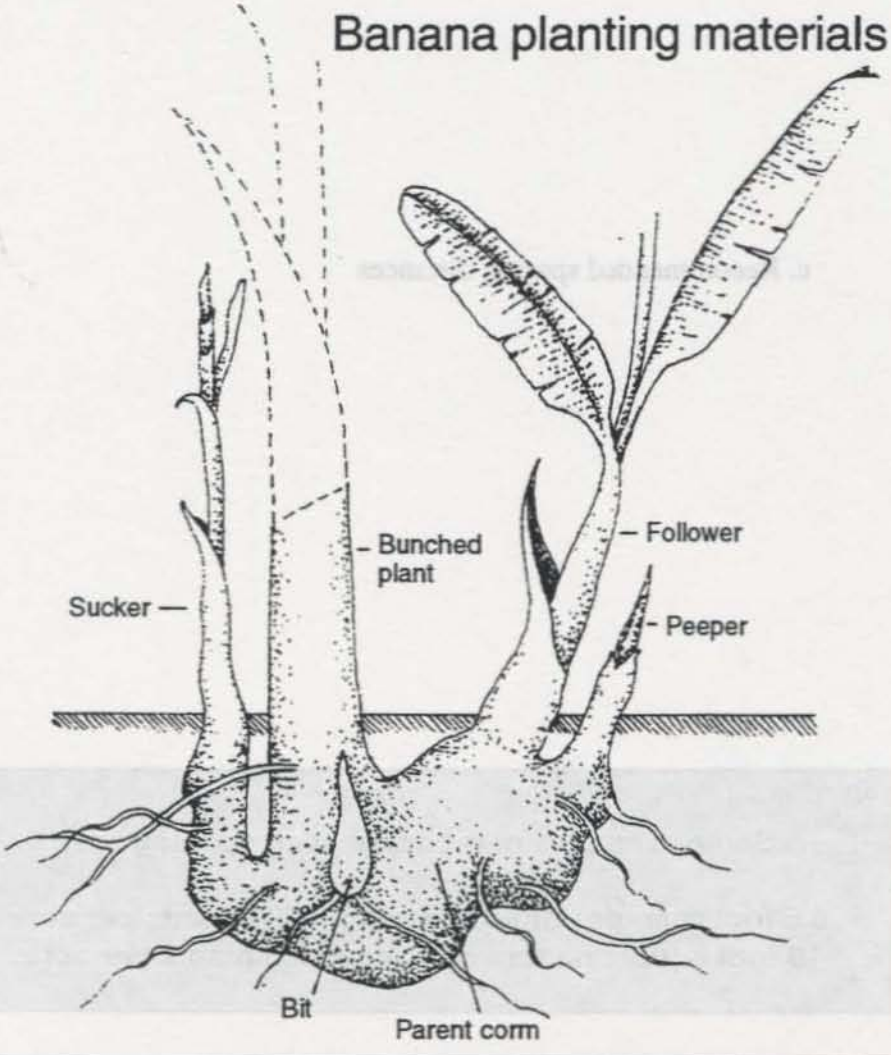
b. Corms and suckers

c BIT

d. PEEPER

e. Sword suckers

f. FOLLOWER




SA

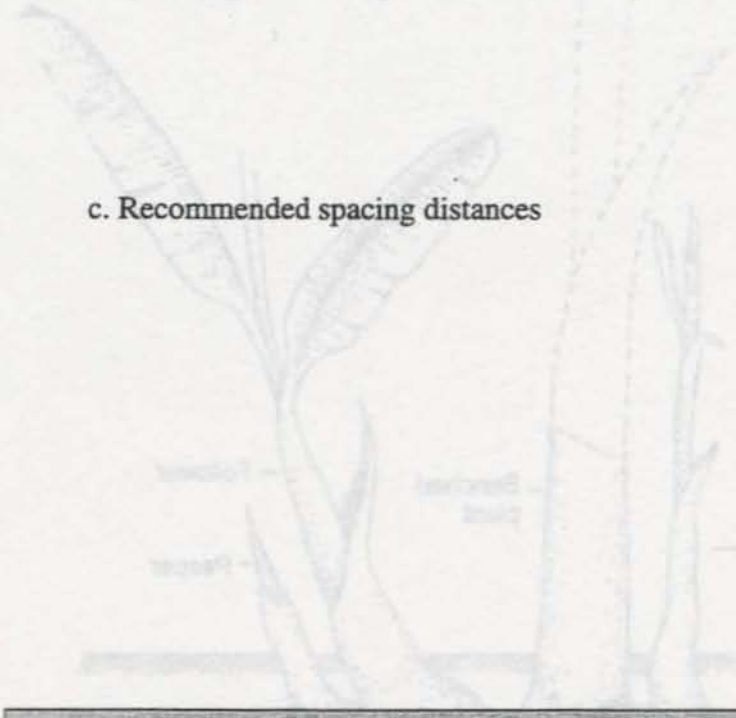
Observe and handle the different types of planting materials in the classroom or in the field.

2. **What is the best crop density for banana production?**

a. Bananas are planted closer than most crop plants for two reasons.

b. Three factors affect the distance between banana plants.

c. Recommended spacing distances



**Some examples of recommended spacing are:**

**8.5 foot triangle pattern spacing = 700 plants per acre**
**10 foot square pattern spacing = 435 plants per acre.**

# III. Managing a Banana Plantation

Many banana plantations may increase profits if additional management practices are used. The proper management of a banana plantation can make the difference between success and failure.

## A. Weed and Fertility Management

1. **What are the most effective weed control practices?**

a. During the first four months after planting

b. From four months until the bananas completely shade the ground

2. **What are the best soil fertility practices?**

a. All bananas require fertilizer for highest production.

b. Three major benefits

c. Best ratio for a complete (N-P-K) fertilizer

d. Continuous supply of nutrients

e. False stems and leaves

f. Soil and leaf tests

**B. Desuckering**

Desuckering is one of the most important jobs in managing the plantation. Yet it is the practice which is most often not done.

1. **Why should bananas be desuckered?**

a. DESUCKERING

b. More suckers will not yield more fruit.

2. **How should a banana plant look after proper desuckering?**


Visit a banana plantation to see and practice the proper method of desuckering.

a. Main stem

b. MAIDEN

c. Follower or peeper

3. **When should desuckering be done?**

## C. Pest Management

### 1. What are nematodes and how are they controlled?

a. Live in soil and damage roots of banana corms

b. Too small to be seen without a microscope


Look at examples of pest damage to banana roots and corms.

c. Three main ways of controlling nematodes

#### Nematode Control

**Before planting:**

**i. Use ground never planted to bananas or wait at least one year after destroying old banana plants.**

**ii. Soak trimmed and pared planting material in hot water (56° C) for five minutes.**

**After Planting:**

**iii. Spread a chemical nematicide on top of the soil around each plant, every six months.**

### 2. What are banana weevil borers and how are they controlled?

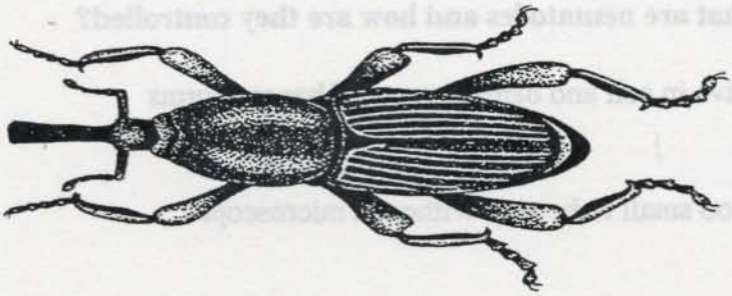
a. A type of black beetle about 1 inch long

i. Dig into banana corms and lay eggs in the hole

ii. Eggs hatch into white caterpillars that bore into the corm

b. Inspect the banana corms for holes and /or caterpillars.

Banana Weevil Borer



c. Three ways of controlling banana weevil borers

Before Planting:

i. Carefully inspect all planting materials

After Planting

ii. Trapping

iii. Chemical

3. **What are banana aphids and how are they controlled?**

a. Banana aphids are very small (1/16 of an inch) flying pests.

b. Bunchy Top disease

Banana Aphid

## D. Disease Management

### 1. What are leaf spot diseases and how are they controlled?

a. Caused by fungi

b. Germinate on a leaf and grow inside

c. There are three important leaf spot diseases:

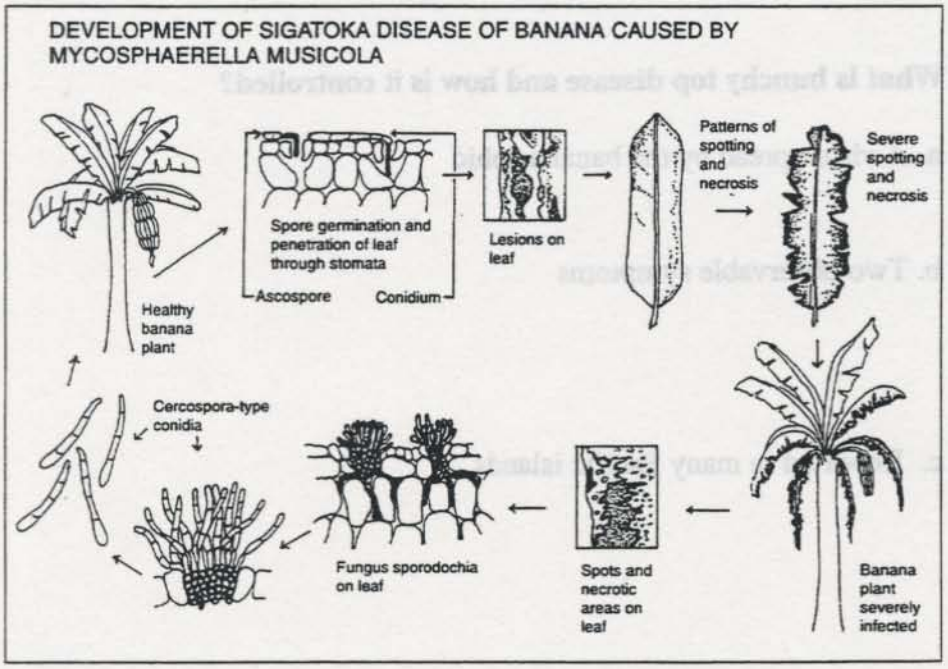
i. Sigatoka Leaf Spot

ii. Black Leaf Streak

iii. Cordana Leaf Spot

SA

Study examples of banana leaves damaged by the different types of leaf spot on your island




d. Leaf spot diseases kill leaves needed for photosynthesis.

e. Two basic rules in preparing fungicide

f. Two basic rules for spraying fungicides

g. Timing is very important in spraying fungicide

2. **What is bunchy top disease and how is it controlled?**

a. A virus spread by the banana aphid

b. Two observable symptoms

c. Reported in many Pacific islands

d. Two effective means of control